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Recent Advances in AFM Technology

JASON CLEVELAND, Asylum Research, an Oxford Instruments Company

We will review several recent advances in commercial Atomic Force Microscopy (AFM) technology. The first is the further miniaturization of cantilevers for AFM which has increased their resonant frequencies and decreased their thermal noise, allowing faster, lower noise measurements. When used in an extremely low-noise AFM, these levers have enabled significant improvements in imaging resolution in air and especially in liquids, including the resolution of individual point defects. The second is quantitative mechanical measurements using multifrequency AC techniques. Previously, the contrast in AM-AFM has been difficult to quantify. Recent work has provided an interpretation of the tapping mode observables that allows unambiguous interpretation of material properties. The AM-FM imaging mode combines normal AM mode with the quantitative and high sensitivity of frequency modulated (FM) mode. The mode provides four observables that can be used to solve for parameters, such as sample modulus, in models of the tip-sample interaction. Finally, we will discuss the benefits of photothermal excitation, a new drive mechanism for AC mode techniques that replaces conventional piezo drive. It vastly improves ease-of-use in liquids and provides greatly improved stability in the cantilever drive response relative to piezo drive. Additionally, the drive provides a near-perfect transfer function to the cantilever, enabling more quantitative interpretation in areas like nanomechanical measurement.

In collaboration with Aleks Labuda, Deron Walters, Mario Viani, Sophia Hohlbauch, Irene Revenko, Marta Kocun, and Roger Proksch, Asylum Research, an Oxford Instruments Company.